

# PROPOSAL FOR RAMC (REMOTE ANTENNA MOUNT CONTROLLER)

## TEAM RAR:

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# AGENDA



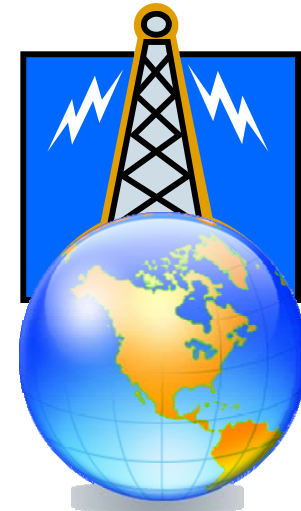
- ❑ Project Background
- ❑ Problem Formulation
- ❑ Design Requirements
- ❑ Environmental Issues
- ❑ Solution Approaches
- ❑ Tasks and Project Management
- ❑ Budget and Resources
- ❑ Conclusion

# PROJECT BACKGROUND



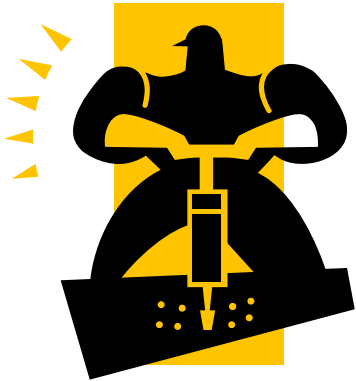
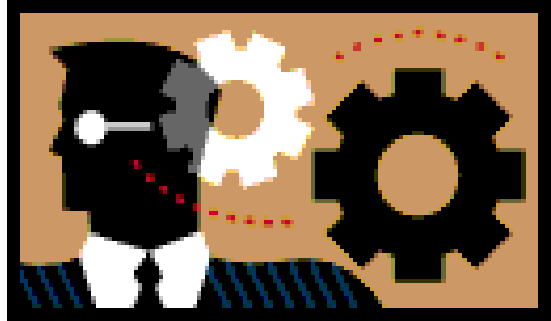
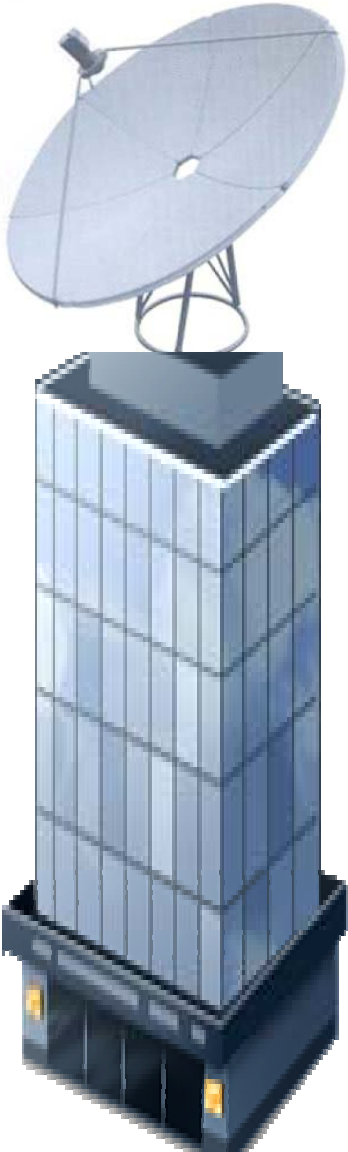
- Telecommunications systems utilize “cell” technology
  - Requires transceiver for each specific zone
  - Multiple stations for complete geographical region

# PROJECT BACKGROUND



- ❑ Conspicuous installation of antennas is required to avoid obstruction/interference (e.g. towers, masts)

# We need to reposition the antenna!

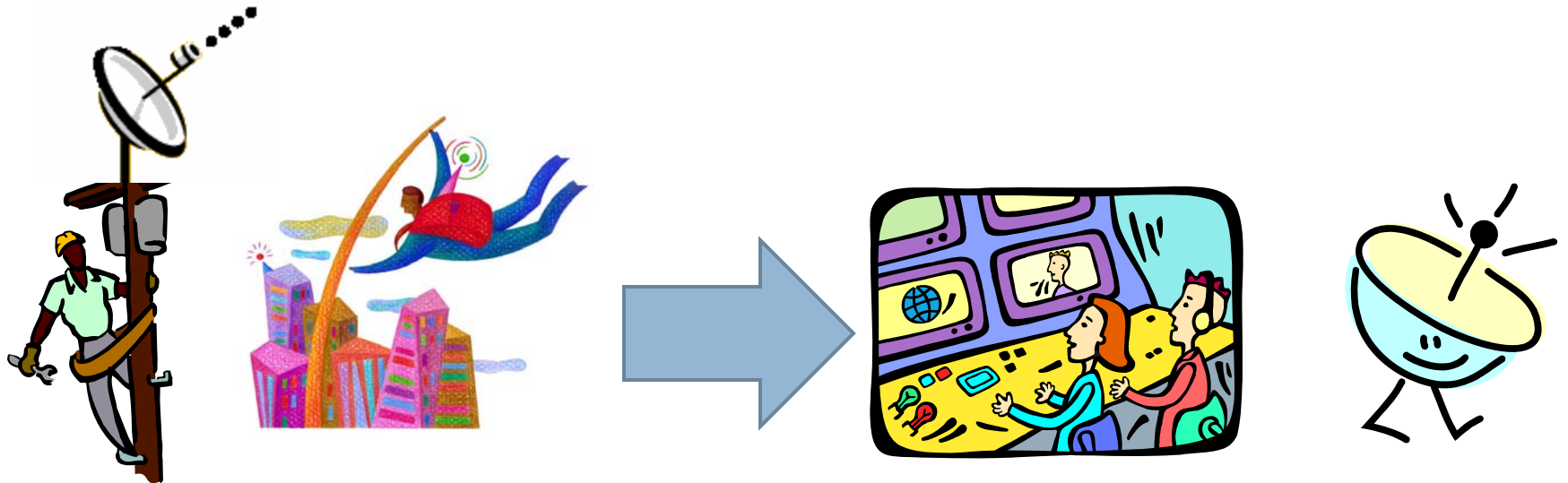


Ho No!

Call Team  
RAR!



# PROJECT BACKGROUND



- ❑ Antenna re-adjustment is often required
- ❑ Manual adjustments of antenna are cumbersome and dangerous
- ❑ With RAMC, antenna adjustments can be made wirelessly

# PROBLEM FORMULATION

- ❑ Our design will address these problems by providing:
  - Wireless adjustment of Antenna
  - A means to store preferable antenna positions
  
- ❑ RAR reduces:
  - inconveniences
  - risks to human life
  - maintenance costs
  - resolution time



# CURRENT STATE OF ART



- ❑ RFS Antenna mounting Hardware and Accessories



- ❑ Sell Indoor Antenna with remote control rotating function TNY-009



- ❑ Philips SDW1850/17 Antenna Remote-Controlled Rotor

- ❑ Adjustable antenna mount with rotatable antenna brackets for PCS and other antennas: US Patent 6222504

- ❑ Adjustable antenna mount: US Patent 4563687

# DESIGN REQUIREMENTS

## □ Design Constraints:

- Response time of at most 60 seconds.
- Speed of antenna motion at least 1 rev/min
- Compliance with all Environmental regulations and standards
- Accuracy within (+-)5 to 10 degrees
- Cost estimated to be \$1500
- Wireless transmission of data
- 0.54W rated power with low current
- Annual maintenance



# DESIGN REQUIREMENTS



## □ Required Knowledge content:

- Linear controls
- Microcontrollers
- Electronics
- Xilinx
- Electromagnetic Theory
- Probability
- SimuLink

# STANDARDS

- ❑ Environmental Standards: IEEE Standard ISO 1680
- ❑ IEEE 802.15.4-2006: for low-rate wireless personal area networks
- ❑ Unlicensed Broadcasting: FCC CFR 47 part 15



# DEFENDERS OF THE ENVIRONMENT

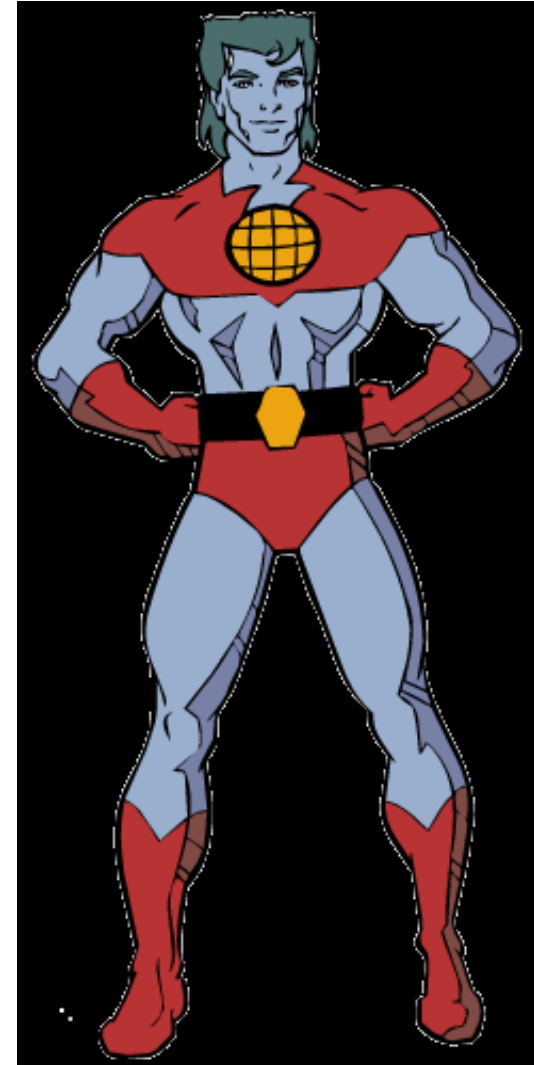
He was 98 lbs. of solid nerd  
until he became...



The first Super-Hero...from New Jersey!

Starring ANDREE MARANDA • MITCHELL COHEN • PAT RYAN, JR. • JENNIFER BASTIST • ROBERT PRICHARD • CINDY MANION • GARY SCHNEIDER • MARK TORGE,  
Directors of Photography JAMES LONDON and LLOYD KAUFMAN • Written by JOE RITTER • Edited by RICHARD HANES • Associate Producer STUART STRUTIN  
Music Consultant MARC KATZ • Directed by MICHAEL HERZ and SAMUEL WEIL • Produced by LLOYD KAUFMAN and MICHAEL HERZ From TROMA, INC.  
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DUO TO THE NATURE OF THIS FILM  
NO ONE UNDER 17 WILL BE ADMITTED.



# ENVIRONMENTAL REGULATIONS

## ❑ Electromagnetic Radiation:

- Standards for Human Exposure to Electric, Magnetic and Electromagnetic Fields: IEC TC106 and FCC §§1.1310
- The International Electrotechnical Commission (IEC) Regulation TC106



## ❑ Pollution:

IEEE 1680 regulation for Environmental Assessment restricts the amount of hazardous substances (RoHS)

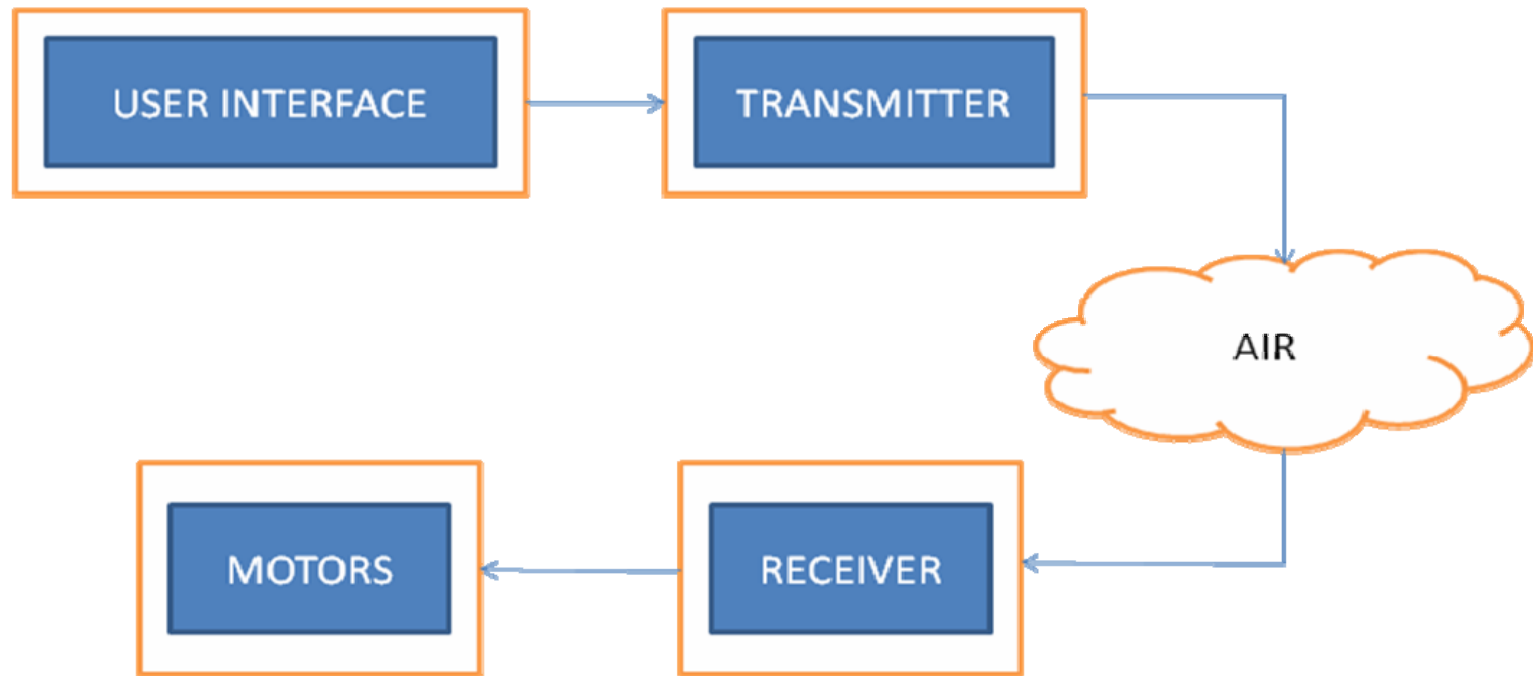
# PROPOSED SOLUTION



Design Objective: to provide an automated module that

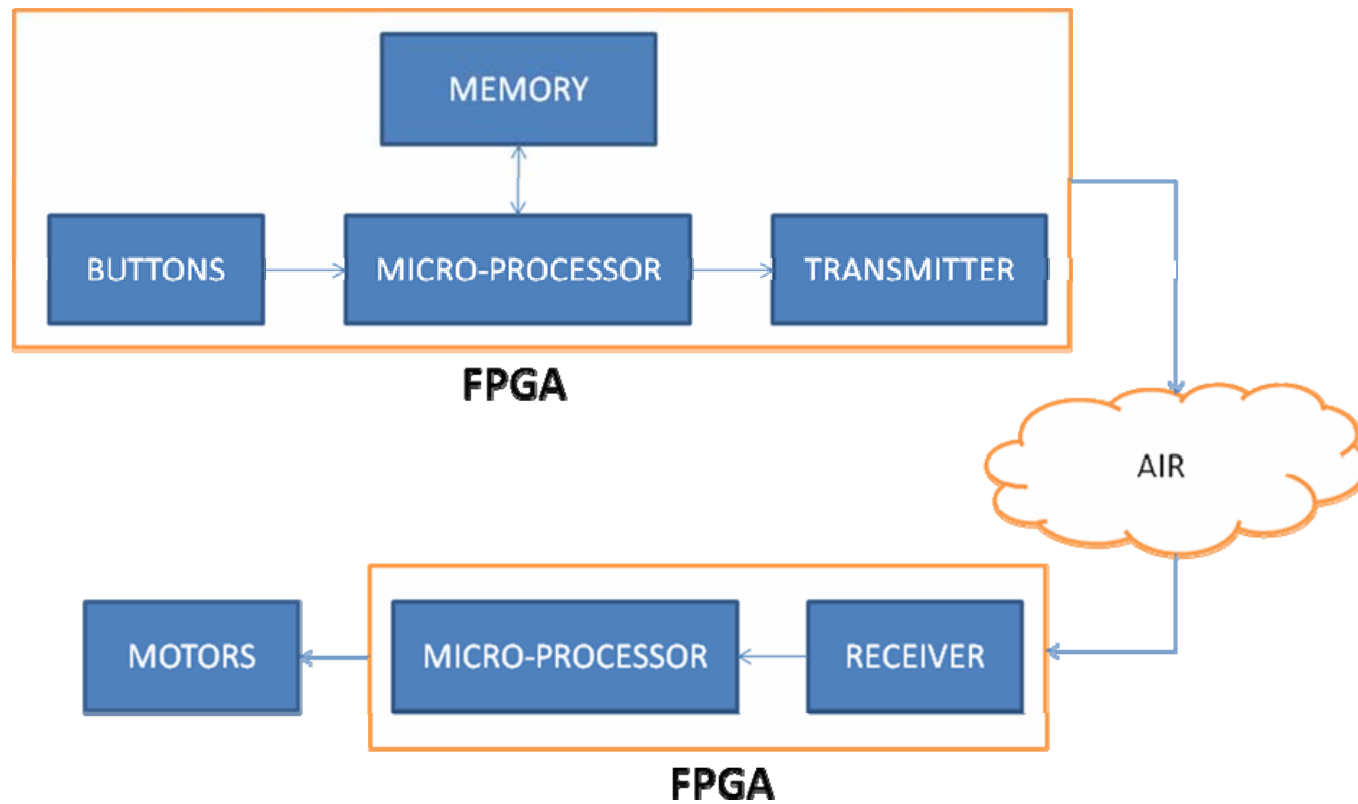
- ❑ provides support for antennae
- ❑ allows adequate control over tilt and azimuth with remote command signaling and control
- ❑ provide a means to store default positions of the antenna in memory for automatic repositioning

# PROPOSED SOLUTION



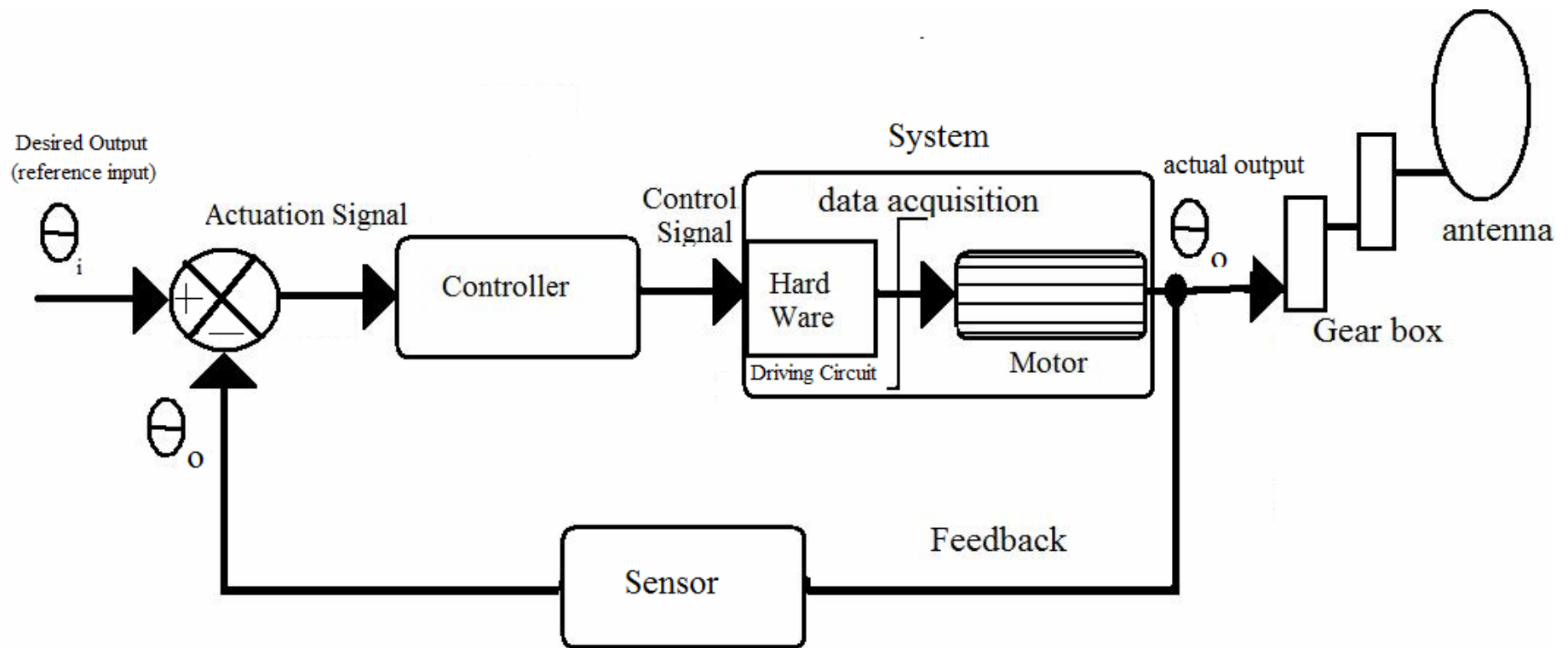
Top Level Block Diagram

# PROPOSED SOLUTION



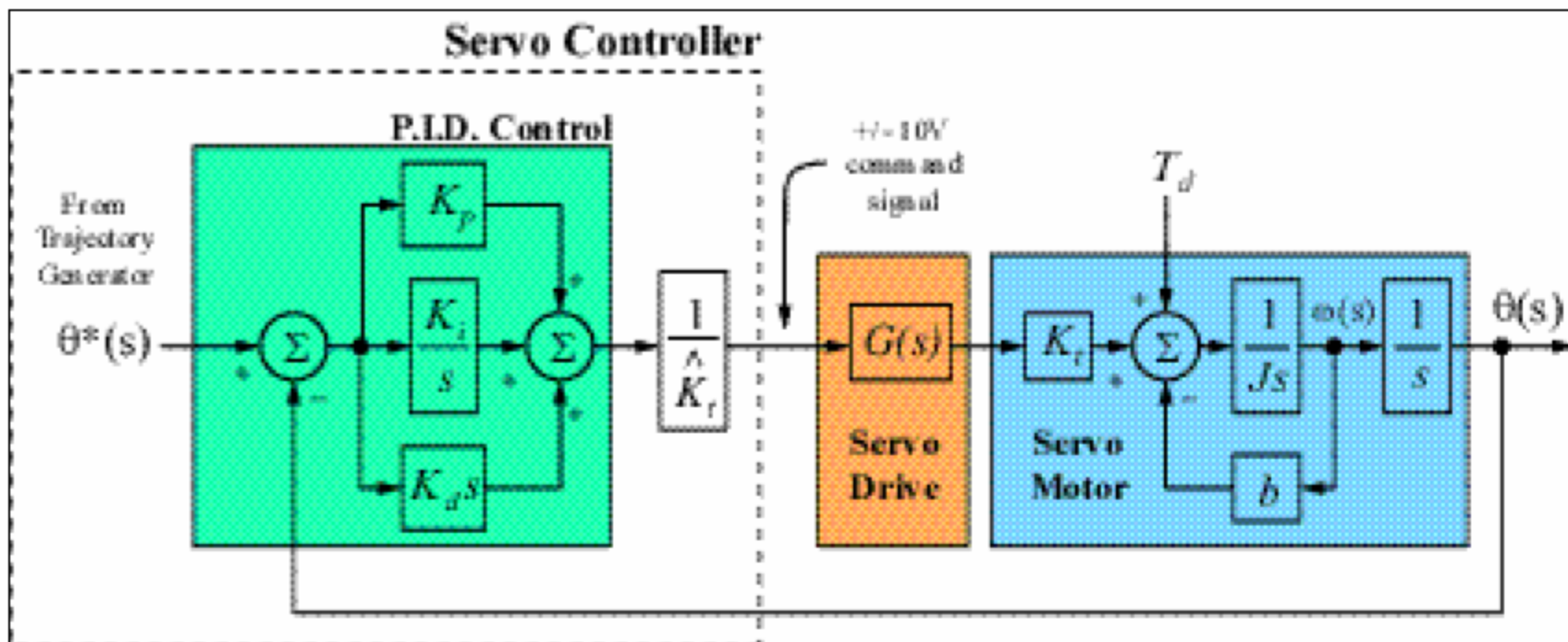
Second Level Block Diagram

# PROPOSED SOLUTION



Closed Feedback Loop for Motor Position Control

# PROPOSED SOLUTION



Inside Closed Feedback Loop for Motor Position Control

# PROPOSED SOLUTION

Motor Sizing equations:

$$\vec{\tau} = \vec{r} \times \vec{F}$$

□ Torque (lb-ft) = Radius (ft) x Force(lb)

$$\vec{s} = \vec{v} / 2\pi r$$

□ Speed (RPM) = v (ft/min) / (2pi x radius(ft))

$$P = \vec{\tau} \cdot 2\pi \vec{s}$$

□ Power (HP) = Torque (lb-ft) x Speed (RPM) / 5252

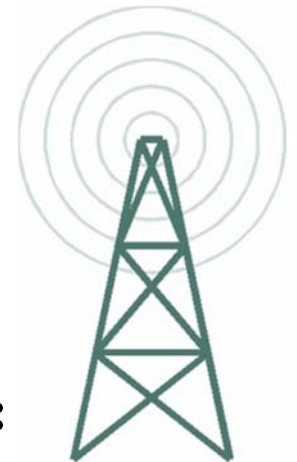
# ALTERNATIVE SOLUTIONS

- **Alternative Transmission techniques:**

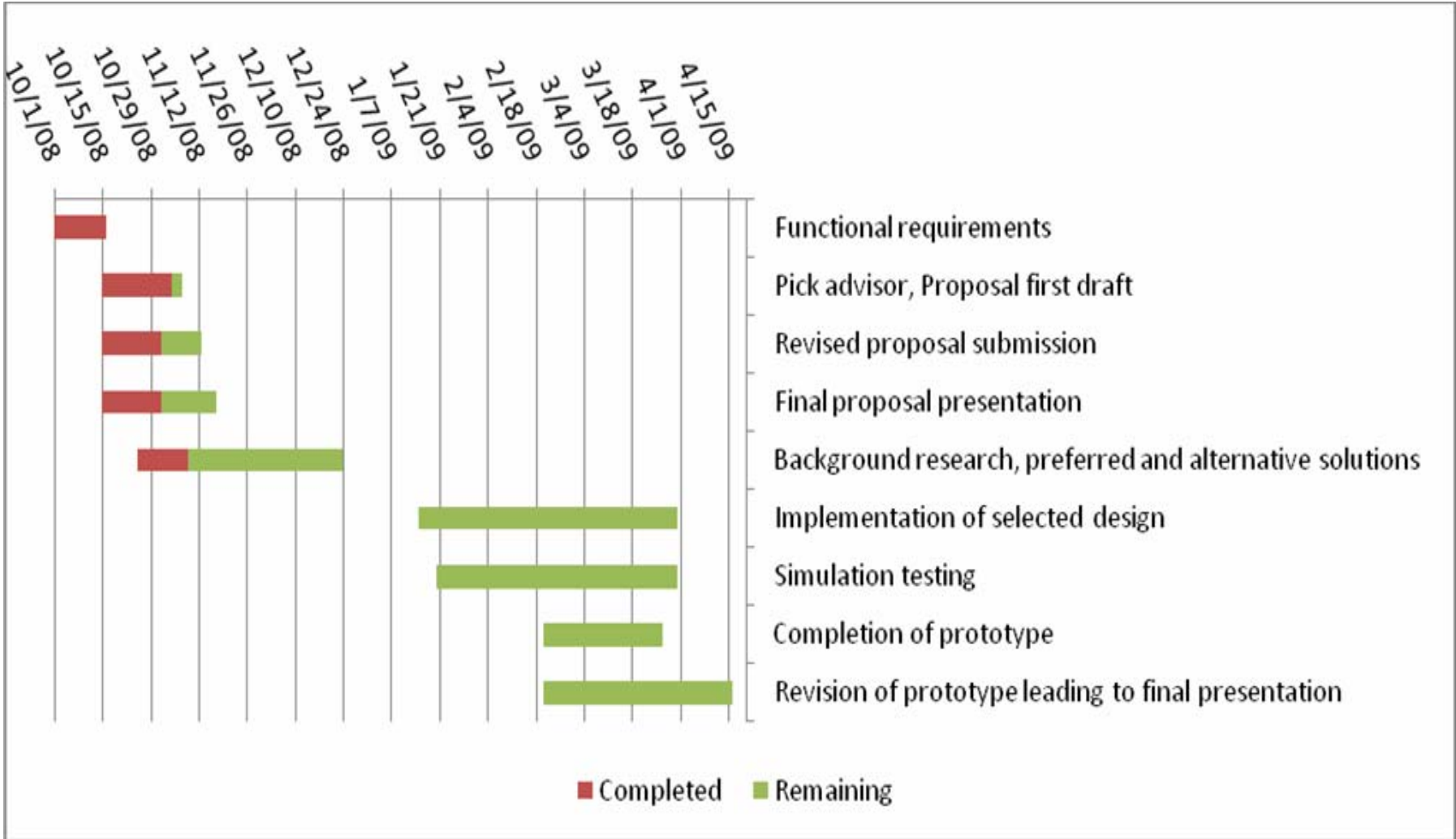
- AM
- Wi-Fi
- Bluetooth

- **Alternative user interfaces and transmitters:**

- Computer Controlled Transmitter and User Interface
- Play Station Pad for User Interface



# TASKS AND PROJECT MANAGEMENT



# VERIFICATION PLAN AND DELIVERABLES



To verify our design extensive simulation will be run using:

- ❑ Xilinx
- ❑ Simulink and D-Space

At the end of the project, the team will deliver:

- ❑ Functional prototype to demonstrate remote antenna controller's capability
- ❑ Detailed documentation and schematics of design

# COSTS AND RESOURCES

Cost of servomotor (4 @ \$150/per):	\$600
Cost of FPGA package (2 FPGA boards):	\$500
Mount:	\$100
<u>Miscellaneous:</u>	<u>\$300</u>
<b>Total</b>	<b>\$1500</b>

## Available Resources:

- ❑ Xilinx software and Simulink simulation software
- ❑ Basic knowledge of electronics, digital system design, and other related coursework

# CONCLUSION



- ❑ Once completed, RAMC will:
  - Reduce risk of dangerous and inconvenient manual antenna adjustments
  - Make improvements in signal quality easier to attain
- ❑ Solution wirelessly transmits motion commands to servo motors using microprocessors, FPGA boards, and programming logic
- ❑ RAMC satisfies course requirements and will find valuable applications in industry

# REFERENCES



- ❑ 2004-8 PatentStorm LLC < PatentStorm.com >
- ❑ Senior Design 1 course material <www.hirstbrook.com>
- ❑ Parker Motion Control Systems: White pages  
Kaiser, D. “Fundamentals of Servo Motor Control”
- ❑ National Electrical Safety Code
- ❑ MIT Digital Systems Design Lab <mit.edu/6.111>
- ❑ Section 15.247: FCC Unlicensed Radio Frequency (RF) Emission regulations